

A2 wherein a sequence of two or more continuous methylene groups is detected by means of  $^{13}\text{C}$ -NMR, and a sequence of two consecutive methylene groups and a sequence of three or more consecutive methylene groups are both detected.

Sub B2  
A3 26. (Amended) The olefin polymer as claimed in claims 1, 7, 10, or 16, which has a functional group at the terminal of the main chain.

27. (Amended) A molded product comprising the olefin polymer of 1, 7, 10, or 16.

34. (Amended) A process for preparing an olefin polymer, comprising polymerizing an olefin of 2 to 20 carbon atoms in the presence of an olefin polymerization catalyst comprising the transition metal compound of claim 32, to prepare the olefin polymer. *How different from claim 32?*

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C 35. (Amended) A process for preparing an olefin polymer, comprising polymerizing an olefin of 2 to 20 carbon atoms in the presence of an olefin polymerization catalyst comprising a transition metal compound to prepare a polymer and then bringing the polymer into contact with a functional group-containing compound to prepare an olefin polymer having a functional group at the terminal, said transition metal compound being selected from the group consisting of

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a transition metal compound which is represented by the following formula (I) and has properties that, in a  $\beta$ -agostic structure of a cationic complex wherein one of X in the formula (I) is replaced with a n-propyl group, said structure being measured by a density functional method, the distance between the heteroatom, which has no direct bond to the central metal M and is nearest to the central metal M, and hydrogen at the  $\beta$ -position is not more than 3.0 Å and the electrostatic energy is not more than 10kJ/mol,



wherein M is a transition metal atom selected from Group 3 to Group 11 of the periodic table,

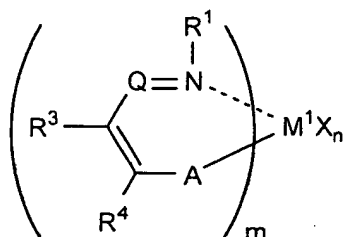
m is an integer of 1 to 5,

n is a number satisfying a valence of M,

L is a ligand coordinated to the central metal M and is a ligand having a heteroatom which has no direct bond to the central metal M, and

X is an oxygen atom, a hydrogen atom, a halogen atom, a hydrocarbon group, an oxygen-containing group, a sulfur-containing group, a nitrogen-containing group, a boron-containing group, an aluminum-containing group, a phosphorus-containing group, a halogen-containing group, a heterocyclic compound residue, a silicon-containing group, a germanium-containing group or a tin-containing group, and when n is 2 or greater, plural groups indicated by X may be the same or different, and plural groups indicated by X may be bonded to form a ring:

C1  
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a transition metal compound which is represented by the following formula (II-a)



(II-a)

wherein  $\text{M}^1$  is a transition metal atom selected from Group 3 to Group 11 of the periodic table,

$m$  is an integer of 1 to 5,

$Q$  is a nitrogen atom or a carbon atom having a substituent  $\text{R}^2$ ,

$A$  is an oxygen atom, a sulfur atom, a selenium atom or a nitrogen atom having a substituent  $\text{R}^5$ ,

$\text{R}^1$  is an aromatic hydrocarbon group, an aliphatic hydrocarbon group or an alicyclic hydrocarbon group, selected from (i) phenyl group having, at least one position of the 2-position and the 6-position, when the position of the carbon atom bonded to nitrogen is the 1-position, one or more substituents selected from a halogen atom and a halogen-containing group, or a (ii) phenyl group having, at least one position of the 3-position, the 4-position and the 5-position, and least one substituent selected from a fluorine-containing group having one carbon atom and not more than two fluorine atoms, a fluorine-containing group having two or more carbon atoms, a chlorine atom, a bromine atom, an

iodine atom, a chlorine-containing group, a bromine-containing group and an iodine-containing group, ~~an aromatic hydrocarbon group other than a phenyl group having at least one substituent selected from a halogen atom and a halogen-containing group, an aliphatic hydrocarbon group having at least one substituent selected from a halogen atom and a halogen-containing group, or an alicyclic hydrocarbon group having at least one substituent selected from a halogen atom and a halogen-containing group,~~

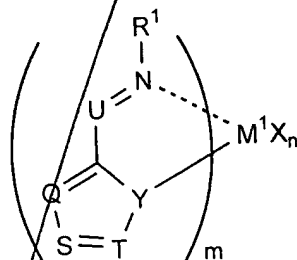
~~R<sup>2</sup> to R<sup>5</sup> may be the same or different and are each a hydrogen atom, a halogen atom, a hydrocarbon group, a hydrocarbon-substituted silyl group, an oxygen-containing group, a nitrogen-containing group, a sulfur-containing group, a boron-containing group, an aluminum-containing group, a phosphorus-containing group, a halogen-containing group, a heterocyclic compound residue, a silicon-containing group, a germanium-containing group, or a tin-containing group, two or more of R<sup>2</sup> to R<sup>5</sup> may be bonded to form a ring, and when m is 2 or greater, R<sup>1</sup>'s, R<sup>2</sup>'s, R<sup>3</sup>'s, R<sup>4</sup>'s, and R<sup>5</sup>'s may be the same or different, and one group of R<sup>2</sup> to R<sup>5</sup> contained in one ligand and one group of R<sup>2</sup> to R<sup>5</sup> contained in other ligands may be bonded,~~

~~n is a number satisfying a valence of M<sup>1</sup>, and~~

~~X is an oxygen atom, a hydrogen atom, a halogen atom, a hydrocarbon group, an oxygen-containing group, a sulfur-containing group, a nitrogen-containing group, a boron-containing group, an aluminum-containing group, a phosphorus-containing group, a halogen-containing group, a heterocyclic compound~~

residue, a silicon-containing group, a germanium-containing group or a tin-containing group, and when  $n$  is 2 or greater, plural groups indicated by  $X$  may be the same or different, and plural groups indicated by  $X$  may be bonded to form a ring;

a transition metal compound which is represented by the following formula (II-b)



(II-b)

wherein  $M^1$  is a transition metal atom selected from Group 3 to Group 11 of the periodic table,

$m$  is an integer of 1 to 5,

$Y$  is a nitrogen atom or a phosphorus atom,

$U$  is a carbon atom having a substituent  $R^6$ , a nitrogen atom or a phosphorus atom,

$Q$  is a carbon atom having a substituent  $R^7$ , a nitrogen atom or a phosphorus atom,

$S$  is a carbon atom having a substituent  $R^8$ , a nitrogen atom or a phosphorus atom,

$T$  is a carbon atom having a substituent  $R^9$ , a nitrogen atom or a phosphorous atom,

$R^1$  is an aromatic hydrocarbon group, an aliphatic

hydrocarbon group or an alicyclic hydrocarbon group, selected from a phenyl group having, at least one position of the 2-position and the 6-position, when the position of the carbon atom bonded to nitrogen is the 1-position, one or more substituents selected from a halogen atom and a halogen-containing group, (or) a phenyl group having, at least one position of the 3-position, the 4-position and the 5-position, at least one substituent selected from a fluorine-containing group having one carbon atom and not more than two fluorine atoms, a fluorine-containing group having two or more carbon atoms, a chlorine atom, a bromine atom, an iodine atom, a chlorine-containing group, a bromine-containing group and an iodine-containing group, an aromatic hydrocarbon group other than a phenyl group having at least one substituent selected from a halogen atom and a halogen-containing group, an aliphatic hydrocarbon group having at least one substituent selected from a halogen atom and a halogen-containing group, or an alicyclic hydrocarbon group having at least one substituent selected from a halogen atom and a halogen-containing group,

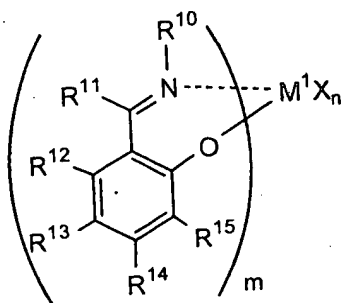
$R^6$  to  $R^9$  may be the same or different and are each a hydrogen atom, a halogen atom, a hydrocarbon group, a hydrocarbon-substituted silyl group, an oxygen-containing group, a nitrogen-containing group, a sulfur-containing group, a boron-containing group, an aluminum-containing group, a phosphorus-containing group, a halogen-containing group, a heterocyclic compound residue, a silicon-containing group, a germanium-containing group or a tin-containing group, two or more of  $R^6$  to

$R^9$  may be bonded to form a ring, and when  $m$  is 2 or greater,  $R^1$ 's,  $R^6$ 's,  $R^7$ ,  $R^8$ 's and  $R^9$ 's may be the same or different, and one group of  $R^6$  to  $R^9$  contained in one ligand and one group of  $R^6$  to  $R^9$  contained in other ligands may be bonded,

$n$  is a number satisfying a valence of  $M^1$ , and

$X$  is an oxygen atom a hydrogen atom, a halogen atom, a hydrocarbon group, an oxygen-containing group, a sulfur-containing group, a nitrogen-containing group, a boron-containing group, an aluminum-containing group, a phosphorus-containing group, a halogen-containing group, a heterocyclic compound residue, a silicon-containing group, a germanium-containing group or a tin-containing group, and when  $n$  is 2 or greater, plural groups indicated by  $X$  may be the same or different, and plural groups indicated by  $X$  may be bonded to form a ring; and

a transition metal compound which is represented by the following formula (III)



(III)

wherein  $M^1$  is a transition metal atom selected from Group 4 to Group 5 of the periodic table,

$m$  is 1 or 2,

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$R^{10}$  is an aromatic hydrocarbon group, an aliphatic hydrocarbon group or an alicyclic hydrocarbon group, when  $R^{10}$  is a phenyl group and the position of the carbon atom bonded to nitrogen is the 1-position, this phenyl group has, at least one position of the 2-position and the 6-position, one or more substituents selected from a heteroatom and a heteroatom-containing group, or has, at least one position of the 3-position, the 4-position and the 5-position, at least one substituent selected from a heteroatom other than a fluorine atom, a fluorine-containing group having one carbon atom and not more than two fluorine atoms, a fluorine-containing group having two or more carbon atoms, and a group containing a heteroatom other than a fluorine atom, and (ii)  $R^{10}$  is an aromatic hydrocarbon group other than a phenyl group, (ii) aliphatic hydrocarbon group or (iii) alicyclic group, this group has at least one substituent selected from a heteroatom and a heteroatom-containing group,

$R^{11}$  to  $R^{14}$  may be the same or different and are each a hydrogen atom, a halogen atom, a halogen-containing group, a hydrocarbon group, a hydrocarbon-substituted silyl group, an oxygen-containing group, a nitrogen-containing group or a sulfur-containing group,

$R^{15}$  is a halogen atom, a halogen-containing group, a hydrocarbon group or a hydrocarbon-substituted silyl group,

$n$  is a number satisfying a valence of  $M$ , and

$X$  is an oxygen atom, a hydrogen atom, a halogen atom, a



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hydrocarbon group, an oxygen-containing group, a sulfur-containing group, a nitrogen-containing group, a boron-containing group, an aluminum-containing group, a phosphorus-containing group, a halogen-containing group, a heterocyclic compound residue, a silicon-containing group, a germanium-containing group or a tin-containing group, and when n is 2 or greater, plural groups indicated by X may be the same or different, and plural groups indicated by X may be bonded to form a ring.

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36. (Amended) A process for preparing an olefin polymer, comprising polymerizing at least two olefins which are selected from olefins of 2 to 20 carbon atoms and have different polymerization reactivities, in the presence of an olefin polymerization catalyst comprising a transition metal compound to prepare a tapered polymer containing a segment wherein composition of two or more monomers continuously changes, said transition metal compound being selected from the group consisting of

a transition metal compound which is represented by the following formula (I) and has properties that, in a  $\beta$ -agostic structure of a cationic complex wherein one of X in the formula (I) is replaced with a n-propyl group, said structure being measured by a density functional method, the distance between the heteroatom, which has no direct bond to the central metal M and is nearest to the central metal M, and hydrogen at the  $\beta$ -position is not more than 3.0 Å and the electrostatic energy is not more

than 10kJ/mol,



wherein M is a transition metal atom selected from Group 3 to Group 11 of the periodic table,

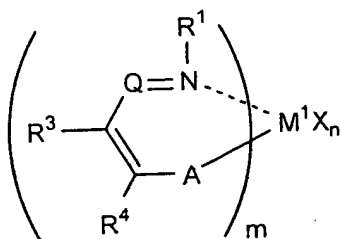
m is an integer of 1 to 5,

n is a number satisfying a valence of M,

L is a ligand coordinated to the central metal M and is a ligand having a heteroatom which has no direct bond to the central metal M, and

X is an oxygen atom, a hydrogen atom, a halogen atom, a hydrocarbon group, an oxygen-containing group, a sulfur-containing group, a nitrogen-containing group, a boron-containing group, an aluminum-containing group, a phosphorus-containing group, a halogen-containing group, a heterocyclic compound residue, a silicon-containing group, a germanium-containing group or a tin-containing group, and when n is 2 or greater, plural groups indicated by X may be the same or different, and plural groups indicated by X may be bonded to form a ring:

a transition metal compound which is represented by the following formula (II-a)



(II-a)

wherein  $M^1$  is a transition metal atom selected from Group 3 to Group 11 of the periodic table,

m is an integer of 1 to 5,

Q is a nitrogen atom or a carbon atom having a substituent  $R^2$ ,

A is an oxygen atom, a sulfur atom, a selenium atom or a nitrogen atom having a substituent  $R^5$ ,

$R^1$  is an aromatic hydrocarbon group, an aliphatic hydrocarbon group or an alicyclic hydrocarbon group, selected from a phenyl group having, at least one position of the 2-position and the 6-position, when the position of the carbon atom bonded to nitrogen is the 1-position, one or more substituents selected from a halogen atom and a halogen-containing group, or a phenyl group having, at least one position of the 3-position, the 4-position and the 5-position, and least one substituent selected from a fluorine-containing group having one carbon atom and not more than two fluorine atoms, a fluorine-containing group having two or more carbon atoms, a chlorine atom, a bromine atom, an iodine atom, a chlorine-containing group, a bromine-containing group and an iodine-containing group, an aromatic hydrocarbon group other than a phenyl group having at least one substituent selected from a halogen atom and a halogen-containing group, an aliphatic hydrocarbon group having at least one substituent selected from a halogen atom and a halogen-containing group, or an alicyclic hydrocarbon group having at least one substituent selected from a halogen atom and a halogen-containing group,

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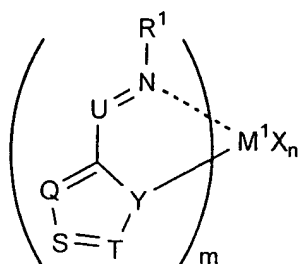
$R^2$  to  $R^5$  may be the same or different and are each a hydrogen atom, a halogen atom, a hydrocarbon group, a hydrocarbon-substituted silyl group, an oxygen-containing group, a nitrogen-containing group, a sulfur-containing group, a boron-containing group, an aluminum-containing group, a phosphorus-containing group, a halogen-containing group, a heterocyclic compound residue, a silicon-containing group, a germanium-containing group, or a tin-containing group, two or more of  $R^2$  to  $R^5$  may be bonded to form a ring, and when  $m$  is 2 or greater,  $R^1$ 's,  $R^2$ 's,  $R^3$ 's,  $R^4$ 's, and  $R^5$ 's may be the same or different, and one group of  $R^2$  to  $R^5$  contained in one ligand and one group of  $R^2$  to  $R^5$  contained in other ligands may be bonded,

$n$  is a number satisfying a valence of  $M^1$ , and

X is an oxygen atom, a hydrogen atom, a halogen atom, a hydrocarbon group, an oxygen-containing group, a sulfur-containing group, a nitrogen-containing group, a boron-containing group, an aluminum-containing group, a phosphorus-containing group, a halogen-containing group, a heterocyclic compound residue, a silicon-containing group, a germanium-containing group or a tin-containing group, and when  $n$  is 2 or greater, plural groups indicated by X may be the same or different, and plural groups indicated by X may be bonded to form a ring;

a transition metal compound which is represented by the following formula (II-b)

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(II-b)

wherein  $M^1$  is a transition metal atom selected from Group 3 to Group 11 of the periodic table,

$m$  is an integer of 1 to 5,

$Y$  is a nitrogen atom or a phosphorus atom,

$U$  is a carbon atom having a substituent  $R^6$ , a nitrogen atom or a phosphorus atom,

$Q$  is a carbon atom having a substituent  $R^7$ , a nitrogen atom or a phosphorus atom,

$S$  is a carbon atom having a substituent  $R^8$ , a nitrogen atom or a phosphorus atom,

$T$  is a carbon atom having a substituent  $R^9$ , a nitrogen atom or a phosphorous atom,

$R^1$  is an aromatic hydrocarbon group, an aliphatic hydrocarbon group or an alicyclic hydrocarbon group, selected from a phenyl group having, at least one position of the 2-position and the 6-position, when the position of the carbon atom bonded to nitrogen is the 1-position, one or more substituents selected from a halogen atom and a halogen-containing group, or a phenyl group having, at least one position of the 3-position, the

4-position and the 5-position, at least one substituent selected from a fluorine-containing group having one carbon atom and not more than two fluorine atoms, a fluorine-containing group having two or more carbon atoms, a chlorine atom, a bromine atom, an iodine atom, a chlorine-containing group, a bromine-containing group and an iodine-containing group, an aromatic hydrocarbon group other than a phenyl group having at least one substituent selected from a halogen atom and a halogen-containing group, an aliphatic hydrocarbon group having at least one substituent selected from a halogen atom and a halogen-containing group, or an alicyclic hydrocarbon group having at least one substituent selected from a halogen atom and a halogen-containing group,

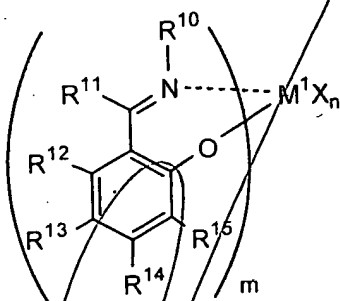
$R^6$  to  $R^9$  may be the same or different and are each a hydrogen atom, a halogen atom, a hydrocarbon group, a hydrocarbon-substituted silyl group, an oxygen-containing group, a nitrogen-containing group, a sulfur-containing group, a boron-containing group, an aluminum-containing group, a phosphorus-containing group, a halogen-containing group, a heterocyclic compound residue, a silicon-containing group, a germanium-containing group or a tin-containing group, two or more of  $R^6$  to  $R^9$  may be bonded to form a ring, and when  $m$  is 2 or greater,  $R^1$ s,  $R^6$ s,  $R^7$ ,  $R^8$ s and  $R^9$ s may be the same or different, and one group of  $R^6$  to  $R^9$  contained in one ligand and one group of  $R^6$  to  $R^9$  contained in other ligands may be bonded,

$n$  is a number satisfying a valence of  $M^1$ , and

$X$  is an oxygen atom a hydrogen atom, a halogen atom, a

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hydrocarbon group, an oxygen-containing group, a sulfur-containing group, a nitrogen-containing group, a boron-containing group, an aluminum-containing group, a phosphorus-containing group, a halogen-containing group, a heterocyclic compound residue, a silicon-containing group, a germanium-containing group or a tin-containing group, and when n is 2 or greater, plural groups indicated by X may be the same or different, and plural groups indicated by X may be bonded to form a ring; and

a transition metal compound which is represented by the following formula (III)



(III)

wherein  $M^1$  is a transition metal atom selected from Group 4 to Group 5 of the periodic table,

$m$  is 1 or 2,

$R^{10}$  is an aromatic hydrocarbon group, an aliphatic hydrocarbon group or an alicyclic hydrocarbon group, when  $R^{10}$  is a phenyl group and the position of the carbon atom bonded to nitrogen is the 1-position, this phenyl group has, at least one position of the 2-position and the 6-position, one or more substituents selected from a heteroatom and a heteroatom-

A4

containing group, or has, at least one position of the 3-position, the 4-position and the 5-position, at least one substituent selected from a heteroatom other than a fluorine atom, a fluorine-containing group having one carbon atom and not more than two fluorine atoms, a fluorine-containing group having two or more carbon atoms, and a group containing a heteroatom other than a fluorine atom, and when  $R^{10}$  is an aromatic hydrocarbon group other than a phenyl group, an aliphatic hydrocarbon group or an alicyclic group, this group has at least one substituent selected from a heteroatom and a heteroatom-containing group,

$R^{11}$  to  $R^{14}$  may be the same or different and are each a hydrogen atom, a halogen atom, a halogen-containing group, a hydrocarbon group, a hydrocarbon-substituted silyl group, an oxygen-containing group, a nitrogen-containing group or a sulfur-containing group,

$R^{15}$  is a halogen atom, a halogen-containing group, a hydrocarbon group or a hydrocarbon-substituted silyl group,

$n$  is a number satisfying a valence of  $M$ , and

$X$  is an oxygen atom, a hydrogen atom, a halogen atom, a hydrocarbon group, an oxygen-containing group, a sulfur-containing group, a nitrogen-containing group, a boron-containing group, an aluminum-containing group, a phosphorus-containing group, a halogen-containing group, a heterocyclic compound residue, a silicon-containing group, a germanium-containing group or a tin-containing group, and when  $n$  is 2 or greater, plural



groups indicated by X may be the same or different, and plural groups indicated by X may be bonded to form a ring.

A4 37. (Amended) A process for preparing an olefin polymer, comprising conducting the following step (1), the following step (2), and optionally, the following step (3) of an arbitrary number of times, to prepare a block copolymer having structure wherein plural polymer blocks are bonded;

(1) a step of polymerizing at least one olefin selected from olefins of 2 to 20 carbon atoms in the presence of an olefin polymerization catalyst comprising a transition metal compound to prepare a polymer block, said transition metal compound being selected from the group consisting of

a transition metal compound which is represented by the following formula (I) and has properties that, in a  $\beta$ -agostic structure of a cationic complex wherein one of X in the formula (I) is replaced with a n-propyl group, said structure being measured by a density functional method, the distance between the heteroatom, which has no direct bond to the central metal M and is nearest to the central metal M, and hydrogen at the  $\beta$ -position is not more than 3.0 Å and the electrostatic energy is not more than 10kJ/mol,



wherein M is a transition metal atom selected from Group 3 to Group 11 of the periodic table,

m is an integer of 1 to 5,

**W** **E** **B** **A** **N**

is a number satisfying a valence of M,  
 is a ligand coordinated to the central metal  
 having a heteroatom which has no direct  
 metal M, and  
 is an oxygen atom, a hydrogen atom, a halogen  
 group, an oxygen-containing group, a carbon  
 group, a nitrogen-containing group, a boron  
 group, an aluminum-containing group, a phosphorus  
 group, a halogen-containing group, a heterocyclic  
 group, a silicon-containing group, a germanium-con-  
 taining group, and when n is 2 or greater,  
 indicated by X may be the same or different  
 indicated by X may be bonded to form a ring:  
 transition metal compound which is represented by the  
 following formula (II-a)

(II-a)

M¹ is a transition metal atom selected from  
 of the periodic table,  
 is an integer of 1 to 5,  
 is a nitrogen atom or a carbon atom having a

(II-a)

 $\mathbb{R}^2,$ 

Q is a nitrogen atom or a carbon atom having a substituent

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A is an oxygen atom, a sulfur atom, a selenium atom or a nitrogen atom having a substituent  $R^5$ ,

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 $R^1$  is an aromatic hydrocarbon group, an aliphatic hydrocarbon group or an alicyclic hydrocarbon group, selected from a phenyl group having, at least one position of the 2-position and the 6-position, when the position of the carbon atom bonded to nitrogen is the 1-position, one or more substituents selected from a halogen atom and a halogen-containing group, or a phenyl group having, at least one position of the 3-position, the 4-position and the 5-position, and least one substituent selected from a fluorine-containing group having one carbon atom and not more than two fluorine atoms, a fluorine-containing group having two or more carbon atoms, a chlorine atom, a bromine atom, an iodine atom, a chlorine-containing group, a bromine-containing group and an iodine-containing group, an aromatic hydrocarbon group other than a phenyl group having at least one substituent selected from a halogen atom and a halogen-containing group, an aliphatic hydrocarbon group having at least one substituent selected from a halogen atom and a halogen-containing group, or an alicyclic hydrocarbon group having at least one substituent selected from a halogen atom and a halogen-containing group,

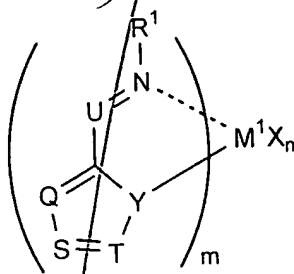
$R^2$  to  $R^5$  may be the same or different and are each a hydrogen atom, a halogen atom, a hydrocarbon group, a hydrocarbon-substituted silyl group, an oxygen-containing group, a nitrogen-containing group, a sulfur-containing group, a boron-containing group, an aluminum-containing group, a phosphorus-

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 containing group, a halogen-containing group, a heterocyclic compound residue, a silicon-containing group, a germanium-containing group, or a tin-containing group, two or more of  $R^2$  to  $R^5$  may be bonded to form a ring, and when  $m$  is 2 or greater,  $R^1$ 's,  $R^2$ 's,  $R^3$ 's,  $R^4$ 's, and  $R^5$ 's may be the same or different, and one group of  $R^2$  to  $R^5$  contained in one ligand and one group of  $R^2$  to  $R^5$  contained in other ligands may be bonded,

$n$  is a number satisfying a valence of  $M^1$ , and

X is an oxygen atom, a hydrogen atom, a halogen atom, a hydrocarbon group, an oxygen-containing group, a sulfur-containing group, a nitrogen-containing group, a boron-containing group, an aluminum-containing group, a phosphorus-containing group, a halogen-containing group, a heterocyclic compound residue, a silicon-containing group, a germanium-containing group or a tin-containing group, and when  $n$  is 2 or greater, plural groups indicated by X may be the same or different, and plural groups indicated by X may be bonded to form a ring;

a transition metal compound which is represented by the following formula (II-b)



(II-b)

wherein  $M^1$  is a transition metal atom selected from Group 3 to Group 11 of the periodic table,

m is an integer of 1 to 5,

Y is a nitrogen atom or a phosphorus atom,

U is a carbon atom having a substituent  $R^6$ , a nitrogen atom or a phosphorus atom,

Q is a carbon atom having a substituent  $R^7$ , a nitrogen atom or a phosphorus atom,

S is a carbon atom having a substituent  $R^8$ , a nitrogen atom or a phosphorus atom,

T is a carbon atom having a substituent  $R^9$ , a nitrogen atom or a phosphorous atom,

$R^1$  is an aromatic hydrocarbon group, an aliphatic hydrocarbon group or an alicyclic hydrocarbon group, selected from a phenyl group having, at least one position of the 2-position and the 6-position, when the position of the carbon atom bonded to nitrogen is the 1-position, one or more substituents selected from a halogen atom and a halogen-containing group, or a phenyl group having, at least one position of the 3-position, the 4-position and the 5-position, at least one substituent selected from a fluorine-containing group having one carbon atom and not more than two fluorine atoms, a fluorine-containing group having two or more carbon atoms, a chlorine atom, a bromine atom, an iodine atom, a chlorine-containing group, a bromine-containing group and an iodine-containing group, an aromatic hydrocarbon group other than a phenyl group having at least one substituent

selected from a halogen atom and a halogen-containing group, an aliphatic hydrocarbon group having at least one substituent selected from a halogen atom and a halogen-containing group, or an alicyclic hydrocarbon group having at least one substituent selected from a halogen atom and a halogen-containing group,

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R<sup>6</sup> to R<sup>9</sup> may be the same or different and are each a hydrogen atom, a halogen atom, a hydrocarbon group, a hydrocarbon-substituted silyl group, an oxygen-containing group, a nitrogen-containing group, a sulfur-containing group, a boron-containing group, an aluminum-containing group, a phosphorus-containing group, a halogen-containing group, a heterocyclic compound residue, a silicon-containing group, a germanium-containing group or a tin-containing group, two or more of R<sup>6</sup> to R<sup>9</sup> may be bonded to form a ring, and when m is 2 or greater, R<sup>1</sup>'s, R<sup>6</sup>'s, R<sup>7</sup>, R<sup>8</sup>'s and R<sup>9</sup>'s may be the same or different, and one group of R<sup>6</sup> to R<sup>9</sup> contained in one ligand and one group of R<sup>6</sup> to R<sup>9</sup> contained in other ligands may be bonded,

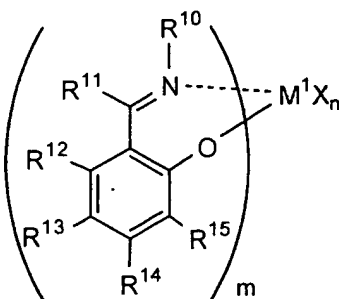
n is a number satisfying a valence of M<sup>1</sup>, and

X is an oxygen atom a hydrogen atom, a halogen atom, a hydrocarbon group, an oxygen-containing group, a sulfur-containing group, a nitrogen-containing group, a boron-containing group, an aluminum-containing group, a phosphorus-containing group, a halogen-containing group, a heterocyclic compound residue, a silicon-containing group, a germanium-containing group or a tin-containing group, and when n is 2 or greater, plural groups indicated by X may be the same or different, and plural

groups indicated by X may be bonded to form a ring; and

a transition metal compound which is represented by the following formula (III)

A4



(III)

wherein  $M^1$  is a transition metal atom selected from Group 4 to Group 5 of the periodic table,

$m$  is 1 or 2,

$R^{10}$  is an aromatic hydrocarbon group, an aliphatic hydrocarbon group or an alicyclic hydrocarbon group, when  $R^{10}$  is a phenyl group and the position of the carbon atom bonded to nitrogen is the 1-position, this phenyl group has, at least one position of the 2-position and the 6-position, one or more substituents selected from a heteroatom and a heteroatom-containing group, or has, at least one position of the 3-position, the 4-position and the 5-position, at least one substituent selected from a heteroatom other than a fluorine atom, a fluorine-containing group having one carbon atom and not more than two fluorine atoms, a fluorine-containing group having two or more carbon atoms, and a group containing a heteroatom other than a fluorine atom, and when  $R^{10}$  is an aromatic

hydrocarbon group other than a phenyl group, an aliphatic hydrocarbon group or an alicyclic group, this group has at least one substituent selected from a heteroatom and a heteroatom-containing group,

$R^{11}$  to  $R^{14}$  may be the same or different and are each a hydrogen atom, a halogen atom, a halogen-containing group, a hydrocarbon group, a hydrocarbon-substituted silyl group, an oxygen-containing group, a nitrogen-containing group or a sulfur-containing group,

$R^{15}$  is a halogen atom, a halogen-containing group, a hydrocarbon group or a hydrocarbon-substituted silyl group,

$n$  is a number satisfying a valence of  $M$ , and

$X$  is an oxygen atom, a hydrogen atom, a halogen atom, a hydrocarbon group, an oxygen-containing group, a sulfur-containing group, a nitrogen-containing group, a boron-containing group, an aluminum-containing group, a phosphorus-containing group, a halogen-containing group, a heterocyclic compound residue, a silicon-containing group, a germanium-containing group or a tin-containing group, and when  $n$  is 2 or greater, plural groups indicated by  $X$  may be the same or different, and plural groups indicated by  $X$  may be bonded to form a ring,

(2) a step of polymerizing at least one olefin selected from olefins of 2 to 20 carbon atoms in the presence of the polymer block prepared in the step (1) to prepare a polymer block which is different from the polymer block prepared in the step (1), and

(3) a step of polymerizing at least one olefin selected from



A4  
olefins of 2 to 20 carbon atoms in the presence of the polymer block prepared in the step (1) and the polymer block prepared in the step (2) to prepare a polymer block which is different from the polymer blocks prepared in the previous step.

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41. (Amended) The process for preparing an olefin polymer as claimed in claim 39, wherein the olefin polymerization catalyst is the catalyst comprising a transition metal compound selected from the group consisting of

a transition metal compound which is represented by the following formula (I) and has properties that, in a  $\beta$ -agostic structure of a cationic complex wherein one of X in the formula (I) is replaced with a n-propyl group, said structure being measured by a density functional method, the distance between the heteroatom, which has no direct bond to the central metal M and is nearest to the central metal M, and hydrogen at the  $\beta$ -position is not more than 3.0 Å and the electrostatic energy is not more than 10kJ/mol,



wherein M is a transition metal atom selected from Group 3 to Group 11 of the periodic table,

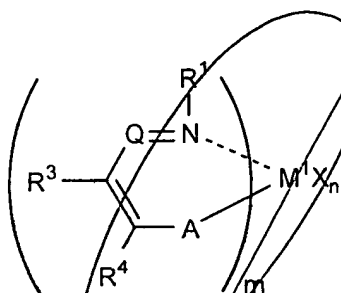
m is an integer of 1 to 5,

n is a number satisfying a valence of M,

L is a ligand coordinated to the central metal M and is a ligand having a heteroatom which has no direct bond to the central metal M, and

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 X is an oxygen atom, a hydrogen atom, a halogen atom, a hydrocarbon group, an oxygen-containing group, a sulfur-containing group, a nitrogen-containing group, a boron-containing group, an aluminum-containing group, a phosphorus-containing group, a halogen-containing group, a heterocyclic compound residue, a silicon-containing group, a germanium-containing group or a tin-containing group, and when n is 2 or greater, plural groups indicated by X may be the same or different, and plural groups indicated by X may be bonded to form a ring:

a transition metal compound which is represented by the following formula (II-a)



(II-a)

wherein M<sup>1</sup> is a transition metal atom selected from Group 3 to Group 11 of the periodic table,

m is an integer of 1 to 5,

Q is a nitrogen atom or a carbon atom having a substituent R<sup>2</sup>,

A is an oxygen atom, a sulfur atom, a selenium atom or a nitrogen atom having a substituent R<sup>5</sup>,

R<sup>1</sup> is an aromatic hydrocarbon group, an aliphatic hydrocarbon group or an alicyclic hydrocarbon group, selected

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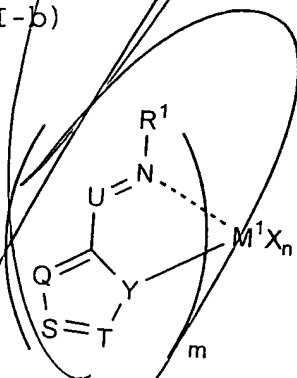
than a phenyl group having  
a halogen atom and a  
hydrocarbon group having  
a halogen atom and a h  
hydrocarbon group havin  
a halogen atom and a hal  
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substituted silyl group,  
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group, an aluminum-contai  
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group, or a tin-containing  
ded to form a ring, and w

$R^2$ 's,  $R^3$ 's,  $R^4$ 's, and  $R^5$ 's may be the same or different, and one group of  $R^2$  to  $R^5$  contained in one ligand and one group of  $R^2$  to  $R^5$  contained in other ligands may be bonded,

$n$  is a number satisfying a valence of  $M^1$ , and

AS  
X is an oxygen atom, a hydrogen atom, a halogen atom, a hydrocarbon group, an oxygen-containing group, a sulfur-containing group, a nitrogen-containing group, a boron-containing group, an aluminum-containing group, a phosphorus-containing group, a halogen-containing group, a heterocyclic compound residue, a silicon-containing group, a germanium-containing group or a tin-containing group, and when  $n$  is 2 or greater, plural groups indicated by X may be the same or different, and plural groups indicated by X may be bonded to form a ring;

a transition metal compound which is represented by the following formula (II-b)



(II-b)

wherein  $M^1$  is a transition metal atom selected from Group 3 to Group 11 of the periodic table,

$m$  is an integer of 1 to 5,

Y is a nitrogen atom or a phosphorus atom,

U is a carbon atom having a substituent  $R^6$ , a nitrogen atom

or a phosphorus atom,

Q is a carbon atom having a substituent R<sup>7</sup>, a nitrogen atom or a phosphorus atom,

S is a carbon atom having a substituent R<sup>8</sup>, a nitrogen atom or a phosphorus atom,

T is a carbon atom having a substituent R<sup>9</sup>, a nitrogen atom or a phosphorous atom,

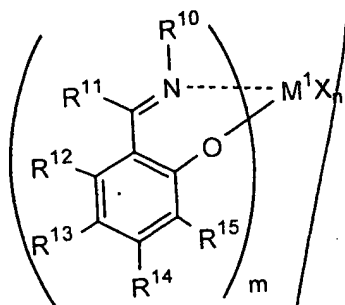
R<sup>1</sup> is an aromatic hydrocarbon group, an aliphatic hydrocarbon group or an alicyclic hydrocarbon group, selected from a phenyl group having, at least one position of the 2-position and the 6-position, when the position of the carbon atom bonded to nitrogen is the 1-position, one or more substituents selected from a halogen atom and a halogen-containing group, or a phenyl group having, at least one position of the 3-position, the 4-position and the 5-position, at least one substituent selected from a fluorine-containing group having one carbon atom and not more than two fluorine atoms, a fluorine-containing group having two or more carbon atoms, a chlorine atom, a bromine atom, an iodine atom, a chlorine-containing group, a bromine-containing group and an iodine-containing group, an aromatic hydrocarbon group other than a phenyl group having at least one substituent selected from a halogen atom and a halogen-containing group, an aliphatic hydrocarbon group having at least one substituent selected from a halogen atom and a halogen-containing group, or an alicyclic hydrocarbon group having at least one substituent selected from a halogen atom and a halogen-containing group,

AS  
 R<sup>6</sup> to R<sup>9</sup> may be the same or different and are each a hydrogen atom, a halogen atom, a hydrocarbon group, a hydrocarbon-substituted silyl group, an oxygen-containing group, a nitrogen-containing group, a sulfur-containing group, a boron-containing group, an aluminum-containing group, a phosphorus-containing group, a halogen-containing group, a heterocyclic compound residue, a silicon-containing group, a germanium-containing group or a tin-containing group, two or more of R<sup>6</sup> to R<sup>9</sup> may be bonded to form a ring, and when m is 2 or greater, R<sup>1</sup>'s, R<sup>6</sup>'s, R<sup>7</sup>, R<sup>8</sup>'s and R<sup>9</sup>'s may be the same or different, and one group of R<sup>6</sup> to R<sup>9</sup> contained in one ligand and one group of R<sup>6</sup> to R<sup>9</sup> contained in other ligands may be bonded,

n is a number satisfying a valence of M<sup>1</sup>, and

X is an oxygen atom a hydrogen atom, a halogen atom, a hydrocarbon group, an oxygen-containing group, a sulfur-containing group, a nitrogen-containing group, a boron-containing group, an aluminum-containing group, a phosphorus-containing group, a halogen-containing group, a heterocyclic compound residue, a silicon-containing group, a germanium-containing group or a tin-containing group, and when n is 2 or greater, plural groups indicated by X may be the same or different, and plural groups indicated by X may be bonded to form a ring; and

a transition metal compound which is represented by the following formula (III)



(III)

wherein  $M^1$  is a transition metal atom selected from Group 4 to Group 5 of the periodic table,

$m$  is 1 or 2,

$R^{10}$  is an aromatic hydrocarbon group, an aliphatic hydrocarbon group or an alicyclic hydrocarbon group, when  $R^{10}$  is a phenyl group and the position of the carbon atom bonded to nitrogen is the 1-position, this phenyl group has, at least one position of the 2-position and the 6-position, one or more substituents selected from a heteroatom and a heteroatom-containing group, or has, at least one position of the 3-position, the 4-position and the 5-position, at least one substituent selected from a heteroatom other than a fluorine atom, a fluorine-containing group having one carbon atom and not more than two fluorine atoms, a fluorine-containing group having two or more carbon atoms, and a group containing a heteroatom other than a fluorine atom, and when  $R^{10}$  is an aromatic hydrocarbon group other than a phenyl group, an aliphatic hydrocarbon group or an alicyclic group, this group has at least one substituent selected from a heteroatom and a heteroatom-containing group,

$R^{11}$  to  $R^{14}$  may be the same or different and are each a

hydrogen atom, a halogen atom, a halogen-containing group, a hydrocarbon group, a hydrocarbon-substituted silyl group, an oxygen-containing group, a nitrogen-containing group or a sulfur-containing group,

$R^{15}$  is a halogen atom, a halogen-containing group, a hydrocarbon group or a hydrocarbon-substituted silyl group,

$n$  is a number satisfying a valence of  $M$ , and

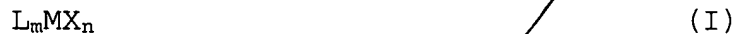
$X$  is an oxygen atom, a hydrogen atom, a halogen atom, a hydrocarbon group, an oxygen-containing group, a sulfur-containing group, a nitrogen-containing group, a boron-containing group, an aluminum-containing group, a phosphorus-containing group, a halogen-containing group, a heterocyclic compound residue, a silicon-containing group, a germanium-containing group or a tin-containing group, and when  $n$  is 2 or greater, plural groups indicated by  $X$  may be the same or different, and plural groups indicated by  $X$  may be bonded to form a ring.

42. (Amended) The process for preparing an olefin polymer as claimed in claim 39, wherein an olefin polymerization catalyst, an olefin polymer, the tapered polymer or the olefin block copolymer of claim 1, 7, 10 or 16 is prepared, said olefin polymerization catalyst comprising a transition metal compound selected from the group consisting of

a transition metal compound which is represented by the following formula (I) and has properties that, in a  $\beta$ -agostic structure of a cationic complex wherein one of  $X$  in the formula



(I) is replaced with a n-propyl group, said structure being measured by a density functional method, the distance between the heteroatom, which has no direct bond to the central metal M and is nearest to the central metal M, and hydrogen at the  $\beta$ -position is not more than 3.0 Å and the electrostatic energy is not more than 10kJ/mol,



wherein M is a transition metal atom selected from Group 3 to Group 11 of the periodic table,

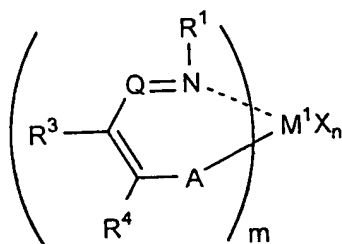
m is an integer of 1 to 5,

n is a number satisfying a valence of M,

L is a ligand coordinated to the central metal M and is a ligand having a heteroatom which has no direct bond to the central metal M, and

X is an oxygen atom, a hydrogen atom, a halogen atom, a hydrocarbon group, an oxygen-containing group, a sulfur-containing group, a nitrogen-containing group, a boron-containing group, an aluminum-containing group, a phosphorus-containing group, a halogen-containing group, a heterocyclic compound residue, a silicon-containing group, a germanium-containing group or a tin-containing group, and when n is 2 or greater, plural groups indicated by X may be the same or different, and plural groups indicated by X may be bonded to form a ring:

a transition metal compound which is represented by the following formula (II-a)



(II-a)

wherein M1 is a transition metal atom selected from Group 3 to Group 11 of the periodic table,

m is an integer of 1 to 5,

Q is a nitrogen atom or a carbon atom having a substituent R<sup>2</sup>,

A is an oxygen atom, a sulfur atom, a selenium atom or a nitrogen atom having a substituent R<sup>5</sup>,

R<sup>1</sup> is an aromatic hydrocarbon group, an aliphatic hydrocarbon group or an alicyclic hydrocarbon group, selected from a phenyl group having, at least one position of the 2-position and the 6-position, when the position of the carbon atom bonded to nitrogen is the 1-position, one or more substituents selected from a halogen atom and a halogen-containing group, or a phenyl group having, at least one position of the 3-position, the 4-position and the 5-position, and least one substituent selected from a fluorine-containing group having one carbon atom and not more than two fluorine atoms, a fluorine-containing group having two or more carbon atoms, a chlorine atom, a bromine atom, an iodine atom, a chlorine-containing group, a bromine-containing group and an iodine-containing group, an aromatic hydrocarbon group other than a phenyl group having at least one substituent

selected from a halogen atom and a halogen-containing group, an aliphatic hydrocarbon group having at least one substituent selected from a halogen atom and a halogen-containing group, or an alicyclic hydrocarbon group having at least one substituent selected from a halogen atom and a halogen-containing group,

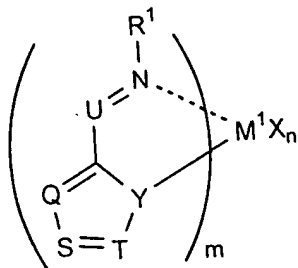
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R<sup>2</sup> to R<sup>5</sup> may be the same or different and are each a hydrogen atom, a halogen atom, a hydrocarbon group, a hydrocarbon-substituted silyl group, an oxygen-containing group, a nitrogen-containing group, a sulfur-containing group, a boron-containing group, an aluminum-containing group, a phosphorus-containing group, a halogen-containing group, a heterocyclic compound residue, a silicon-containing group, a germanium-containing group, or a tin-containing group, two or more of R<sup>2</sup> to R<sup>5</sup> may be bonded to form a ring, and when m is 2 or greater, R<sup>1</sup>s, R<sup>2</sup>s, R<sup>3</sup>s, R<sup>4</sup>s, and R<sup>5</sup>s may be the same or different, and one group of R<sup>2</sup> to R<sup>5</sup> contained in one ligand and one group of R<sup>2</sup> to R<sup>5</sup> contained in other ligands may be bonded,

n is a number satisfying a valence of M<sup>1</sup>, and

X is an oxygen atom, a hydrogen atom, a halogen atom, a hydrocarbon group, an oxygen-containing group, a sulfur-containing group, a nitrogen-containing group, a boron-containing group, an aluminum-containing group, a phosphorus-containing group, a halogen-containing group, a heterocyclic compound residue, a silicon-containing group, a germanium-containing group or a tin-containing group, and when n is 2 or greater, plural groups indicated by X may be the same or different, and plural

groups indicated by X may be bonded to form a ring;

a transition metal compound which is represented by the following formula (II-b)



(II-b)

wherein  $M^1$  is a transition metal atom selected from Group 3 to Group 11 of the periodic table,

$m$  is an integer of 1 to 5,

$Y$  is a nitrogen atom or a phosphorus atom,

$U$  is a carbon atom having a substituent  $R^6$ , a nitrogen atom or a phosphorus atom,

$Q$  is a carbon atom having a substituent  $R^7$ , a nitrogen atom or a phosphorus atom,

$S$  is a carbon atom having a substituent  $R^8$ , a nitrogen atom or a phosphorus atom,

$T$  is a carbon atom having a substituent  $R^9$ , a nitrogen atom or a phosphorous atom,

$R^1$  is an aromatic hydrocarbon group, an aliphatic hydrocarbon group or an alicyclic hydrocarbon group, selected from a phenyl group having, at least one position of the 2-position and the 6-position, when the position of the carbon atom

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bonded to nitrogen is the 1-position, one or more substituents selected from a halogen atom and a halogen-containing group, or a phenyl group having, at least one position of the 3-position, the 4-position and the 5-position, at least one substituent selected from a fluorine-containing group having one carbon atom and not more than two fluorine atoms, a fluorine-containing group having two or more carbon atoms, a chlorine atom, a bromine atom, an iodine atom, a chlorine-containing group, a bromine-containing group and an iodine-containing group, an aromatic hydrocarbon group other than a phenyl group having at least one substituent selected from a halogen atom and a halogen-containing group, an aliphatic hydrocarbon group having at least one substituent selected from a halogen atom and a halogen-containing group, or an alicyclic hydrocarbon group having at least one substituent selected from a halogen atom and a halogen-containing group,

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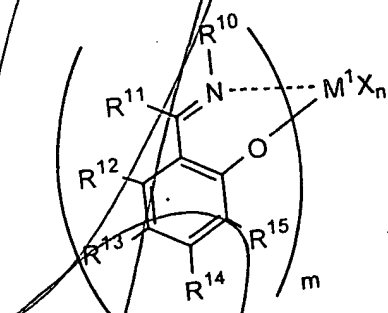
$R^6$  to  $R^9$  may be the same or different and are each a hydrogen atom, a halogen atom, a hydrocarbon group, a hydrocarbon-substituted silyl group, an oxygen-containing group, a nitrogen-containing group, a sulfur-containing group, a boron-containing group, an aluminum-containing group, a phosphorus-containing group, a halogen-containing group, a heterocyclic compound residue, a silicon-containing group, a germanium-containing group or a tin-containing group, two or more of  $R^6$  to  $R^9$  may be bonded to form a ring, and when  $m$  is 2 or greater,  $R^1$ 's,  $R^6$ 's,  $R^7$ ,  $R^8$ 's and  $R^9$ 's may be the same or different, and one group of  $R^6$  to  $R^9$  contained in one ligand and one group of  $R^6$  to  $R^9$

contained in other ligands may be bonded

$n$  is a number satisfying a valence of  $M^1$ , and

$X$  is an oxygen atom a hydrogen atom, a halogen atom, a hydrocarbon group, an oxygen-containing group, a sulfur-containing group, a nitrogen-containing group, a boron-containing group, an aluminum-containing group, a phosphorus-containing group, a halogen-containing group, a heterocyclic compound residue, a silicon-containing group, a germanium-containing group or a tin-containing group, and when  $n$  is 2 or greater, plural groups indicated by  $X$  may be the same or different, and plural groups indicated by  $X$  may be bonded to form a ring; and

a transition metal compound which is represented by the following formula (III)



(III)

wherein  $M^1$  is a transition metal atom selected from Group 4 to Group 5 of the periodic table,

$m$  is 1 or 2,

$R^{10}$  is an aromatic hydrocarbon group, an aliphatic hydrocarbon group or an alicyclic hydrocarbon group, when  $R^{10}$  is a phenyl group and the position of the carbon atom bonded to

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or an alicyclic  
selected from  
may be the  
halogen atom  
o, a hydrocarbon  
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group, a ni  
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AS group, a halogen-containing group, a heterocyclic compound residue, a silicon-containing group, a germanium-containing group or a tin-containing group, and when n is 2 or greater, plural groups indicated by X may be the same or different, and plural groups indicated by X may be bonded to form a ring.

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